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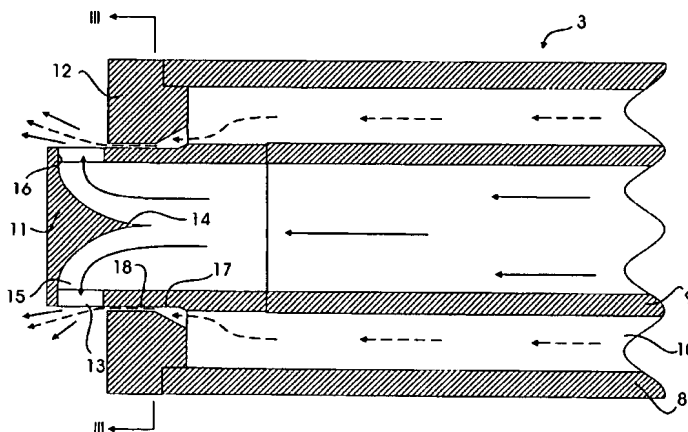
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**Declarations under Rule 4.17:**

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[Continued on next page]

(54) Title: A PLANT FOR COMBUSTION A WASTE OIL



(57) Abstract: A plant serving for combustion of oil, especially waste oil. The plant comprises at least one storage and/or blending tank (1) for the oil, a combustion chamber (2), and at least one associated oil burner (3) with an oil pipe (9) having an oil inlet orifice connected to the oil tank (1) via an oil 10 connection (4) with an oil pump (5), and an air pipe (8) enveloping the oil pipe (9) and together with this pipe defining an air duct (10) with an air inlet orifice connected via an air connection (7) to at least one air blower (6) for generating combustion air. The plant furthermore comprises that the end of the oil pipe (9) opposite the oil inlet orifice is closed by a plug (11), that at least one oil outlet orifice (13) is made in the wall of the oil pipe (9), that the end of the air duct (10) opposite the inlet orifice is closed by a ring (12), and that an air gap (17) is made in this ring or between this ring and the oil pipe, said gap ending upstream of the oil outlet orifice (13). The plant according to the invention has a simple, reliable construction and is able to effectively combust waste oils and heavy oils having even a relatively high content of water.



LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations
- of inventorship (Rule 4.17(iv)) for US only

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

**A plant for combustion of waste oil**

The invention relates to a plant for combustion of oil, especially waste oil, and comprising at least one storage  
5 and/or blending tank for the oil, a combustion chamber, and at least one associated oil burner with an oil pipe having an oil inlet orifice connected to the oil tank via an oil connection with an oil pump, and an air pipe enveloping the oil pipe and together with this oil pipe defining an air duct with an air  
10 inlet orifice connected via an air connection to at least one air blower for generating combustion air.

Waste oil from e.g. ships often contains water and solid components that only with difficulty can be combusted by means  
15 of conventionally constructed burner nozzles which in use quickly would block up. Similar circumstances exist at combustion of heavy oil.

With a view to solve this problem the patent document US  
20 4,141,505 suggests application of an oil burner with a nozzle that has two sections divided by a cavity and each provided with a number of nozzle orifices for allowing a flow of oil from a joint oil intake to pass under pressure simultaneously with the oil flow being intersected by a circulating second  
25 oil flow in the cavity.

This solution is suitable for combustion of heavy oils with e.g. particular impurities. But the obtained degree of atomization is insufficient to completely combust heavy oils  
30 and waste oils, and also oils having a relatively high content of water.

In a first aspect of the invention a plant of the kind mentioned in the opening paragraph is provided that  
35 effectively can combust waste oils and heavy oils.

In a second aspect of the invention a plant of the kind mentioned in the opening paragraph is provided that effectively can combust waste oils and heavy oils having a relatively high water content.

5

In a third aspect of the invention a plant of the kind mentioned in the opening paragraph is provided that has a simple, reliable construction.

10 The novel and unique feature according to the invention, whereby this is achieved, is the fact that the end of the oil pipe opposite the oil inlet orifice is closed by a plug, that at least one oil outlet orifice is made in the wall of the oil pipe, that the end of the air duct opposite the air inlet  
15 orifice is closed by a ring, and that an air gap is made in this ring or between this ring and the oil pipe, said gap ending upstream of the oil outlet orifice.

By means of this design it is possible to use relatively large  
20 oil outlet orifices which due to their size do not tend to block up. The oil, which flows out of these oil outlet orifices under pressure, is atomized effectively by the air jet which simultaneously is forced under pressure out through the air gap crosswise to the oil flow. Thereby it is possible  
25 to effectively atomize and combust oils having a relatively high water content.

In an advantageous embodiment the oil burner is constructed with several outlet orifices and a plug extending past these  
30 orifices in counterflow direction and constructed with a flow duct for each orifice, whereby the oil flow can flow controllably from the oil pipe to each of the outlet orifices.

An effective control is obtained if the cross-sectional area  
35 of each flow duct increases proportionally with the distance from the associate outlet orifice. Thereby the ideal pressure

according to Bernoulli's pressure equation of a flowing liquid without friction and turbulence is reduced to the least possible.

- 5 The area between the plug and the inside of the oil pipe in each flow duct can have the same size as the area of the associate outlet orifice at the transition to this outlet orifice, whereas the corresponding area at the end of the plug facing in counterflow direction can correspond to the cross-
- 10 sectional area of the oil pipe divided by the number of outlet orifices. Thereby the considerable advantage is obtained in that the area of the flow ducts is continuously reduced in the flow direction whereby the flow rate of the oil is continuously increased to the maximum at the transition to the
- 15 outlet orifices.

Furthermore the intersecting line between the plug and a plane extending partly through the axis of the oil pipe, partly through the centre of each outlet orifice can advantageously

20 be a circle or a parabola with centre or fire point respectively on the inside of the pipe whereby the oil flow is made to change direction without the ideal pressure thereby being reduced noticeably.

- 25 The invention will be explained in greater details below, describing an only exemplary embodiment and giving further advantageous characteristics and technical functions with reference to the drawing, in which

- 30 Fig. 1 is a diagrammatic view of a plant according to the invention,

Fig. 2 is a fractional axial sectional view through an oil burner which is part of the plant in fig. 1,

Fig. 3 is a sectional view taken along the line III-III of fig. 2,

Fig. 4 is a perspective view of a plug belonging to the oil burner in figs. 2 and 3.

In the following it is assumed that the plant according to the invention is for combustion of waste oil from a ship. Oil of this kind is usually heavily polluted and must therefore not be dumped in the ocean where the oil could cause great and often almost irreversible damage to the ocean environment.

The oil is therefore combusted on board to a great extent. But the combustion only takes place with difficulty because the waste oil normally has a high viscosity, is polluted and contains a great deal of water.

Fig. 1 is a diagrammatic view of a plant according to the invention. The plant is mainly composed of a tank 1 with oil to be combusted, a combustion chamber 2, an oil burner 3, an oil connection 4 extending between the tank and oil burner, a pump 5 inserted in the connection 4, an air blower 6, and an air connection 7 between this blower and the oil burner 3.

It is noted that a plant of this kind normally includes several components and functions that are not mentioned above, the present invention in principle concerning the oil burner 3 and its function.

By means of the pump 5, oil is pumped under pressure from the oil tank 1 to the oil burner 3 via the oil connection 4. The plant can for example have several tanks (not shown) for storing and blending respectively the waste oil.

Air for combusting the oil by means of the oil burner 3 in the combustion chamber 2 is generated by the air blower 6 and feed to the oil burner 3 via air connection 7.

- 5 Fig. 2 is an axial sectional view through the oil burner 3, only the front part being shown.

The burner 3 is mainly composed of an air pipe 8 connected to the blower 6 via the air connection 7 and an oil pipe 9  
10 located in the air pipe 8 and connected to the oil tank 1 via the oil connection 4 and the pump 5. The air pipe 8 and the oil pipe 9 together define an annular air duct 10.

During operation the oil is flowing under pressure through the  
15 oil pipe 9 in the direction indicated by the solid line arrows, whereas air is flowing through the air duct 10 in the direction indicated by the broken line arrows.

The oil pipe 9 is closed by a plug 11 and the air duct 10 by a  
20 ring 12. Downstream of the ring 12 are four, in the case shown, oil outlet orifices 13. In other cases the number of oil outlet orifices can be different, for example two, three, or five.

25 The plug 11 is extending in counterflow direction a short distance past the orifices 12 in a section 14 made with a flow duct 15 for each oil outlet orifice 13.

As seen especially in fig. 4 showing the plug 11 in  
30 perspective, the cross-sectional area of the flow duct is increasing in counterflow direction and preferably proportionally with the distance from the associate oil outlet orifice 13 whereby the oil is flowing through the flow channels at increasing rate and with very little loss of ideal  
35 pressure.

The pressure loss is especially very little if the intersecting line between the plug and a plane extending through the oil pipe axis and centre of an oil outlet orifice is extending along a circle or ellipse with centre or fire point respectively located mainly on the inside of the pipe wall.

To avoid to the greatest extent possible that the plug offers resistance to the oil flow at the inlet to the flow ducts, the total area of the ducts are in this area mainly equal to the cross-sectional area of the pipe, or in other words the area located between the plug and inside of oil pipe in each flow duct at the end of the plug facing in counterflow direction corresponds mainly to the cross-sectional area of the oil pipe divided by the number of oil outlet orifices.

To also avoid that the oil flow meets resistance at the transition of the flow ducts to the oil outlet orifices, the flow ducts in the plug are arranged in such a way that their walls pass directly into the inner wall 16 on the part of each oil outlet orifice 13 that is located downstream.

As seen best in fig. 3 showing the oil burner 3 seen from the end, the oil pipe 9 has a slightly smaller diameter than the ring 12 closing the air duct 10. Thereby an air gap 17 is formed between the oil pipe 9 and the ring 12.

Owing to the expedient design described above of the flow ducts of the plug, the waste oil is made to flow out of each outlet orifice at unimpaired speed.

At outflow the outflowing oil is hit by the transverse air flow flowing out through the air gap 17. Due to the thereby generated violent impact between the heavy oil jet and the heavy air jet, the oil is split into a finely atomized oil mist which was intimately blended with the combustion air



during splitting of the oil by this air. Thereby even heavy and polluted waste oil having a significant content of water can advantageously be combusted completely.

## Patent claims

1. A plant for combustion of oil, especially waste oil, and comprising at least one storage and/or blending tank (1) for the oil, a combustion chamber (2), and at least one associated oil burner (3) with an oil pipe (9) having an oil inlet orifice connected to the oil tank (1) via an oil connection (4) with an inserted oil pump (5), and an air pipe (8) enveloping the oil pipe (9) and together with this pipe defining an air duct (10) with an air inlet orifice connected via an air connection (7) to at least one air blower (6) for generating combustion air, **characterized** in that the end of the oil pipe (9) opposite the oil inlet orifice is closed by a plug (11), that at least one oil outlet orifice (13) is made in the wall of the oil pipe (9), that the end of the air duct (10) opposite the air inlet orifice is closed by a ring (12), and that an air gap (17) is made in this ring or between this ring and the oil pipe, said gap ending upstream of the oil outlet orifice (13).
2. A plant according to claim 1, **characterized** in that the plug (11) is extending towards or past an area opposite the mouth of the air gap (17) in counter oil flow direction.
3. A plant according to claim 1 or 2, **characterized** in that the plug (11) is made with a flow duct (15) connecting the at least one oil outlet orifice (13) to the interior of the oil pipe (9).
4. A plant according to claim 1 wherein there are several outlet orifices (13) in the wall of the oil pipe (9), **characterized** in that for each outlet orifice (13) there is a flow duct (15) constructed in the plug (11) and

connecting the respective oil outlet orifice (13) to the interior of the oil pipe (9).

- 5        5.    A plant according to claim 3 or 4, **characterized** in that  
the cross-sectional area of each flow duct (15) increases  
in counterflow direction.
- 10       6.    A plant according to claim 3 or 4, **characterized** in that  
the cross section of each flow duct (15) increases  
proportionally with the distance from the associate oil  
outlet orifice (13).
- 15       7.    A plant according to claim 3, 4, or 5, **characterized** in  
that the intersecting line between the wall of the plug  
(11) and a plane extending through the axis of the oil  
pipe (9) and the centre of an oil outlet orifice (13) is  
extending along a circle with the centre located mainly  
on the inside of the pipe wall.
- 20       8.    A plant according to claim 3, 4, or 5, **characterized** in  
that the intersecting line between the wall of the plug  
(11) and a plane extending through the axis of the oil  
pipe (9) and the centre of an oil outlet orifice (13) is  
extending along a parabola with the fire point located  
25       mainly on the inside of the pipe wall.
- 30       9.    A plant according to any of the claims 3 - 8,  
**characterized** in that the wall of the plug (11) mainly  
follows the part of the inside (16) of each oil outlet  
orifice (13) located downstream.
- 35       10.   A plant according to any of the claims 3 - 9,  
**characterized** in that the area located between the plug  
(11) and inside of oil pipe (9) in each flow duct (15) at  
the end of the plug (11) facing in counterflow direction  
corresponds mainly to the cross-sectional area of the oil

pipe (9) divided by the number of oil outlet orifices  
(13).

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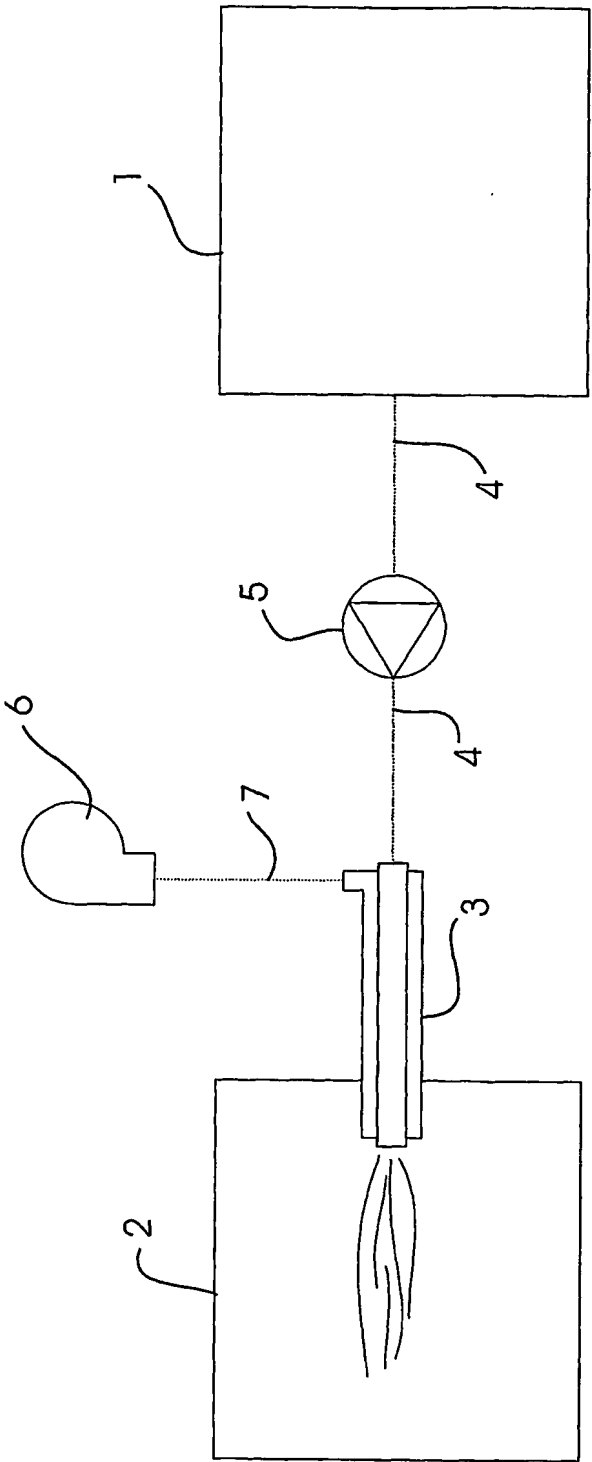


Fig. 1

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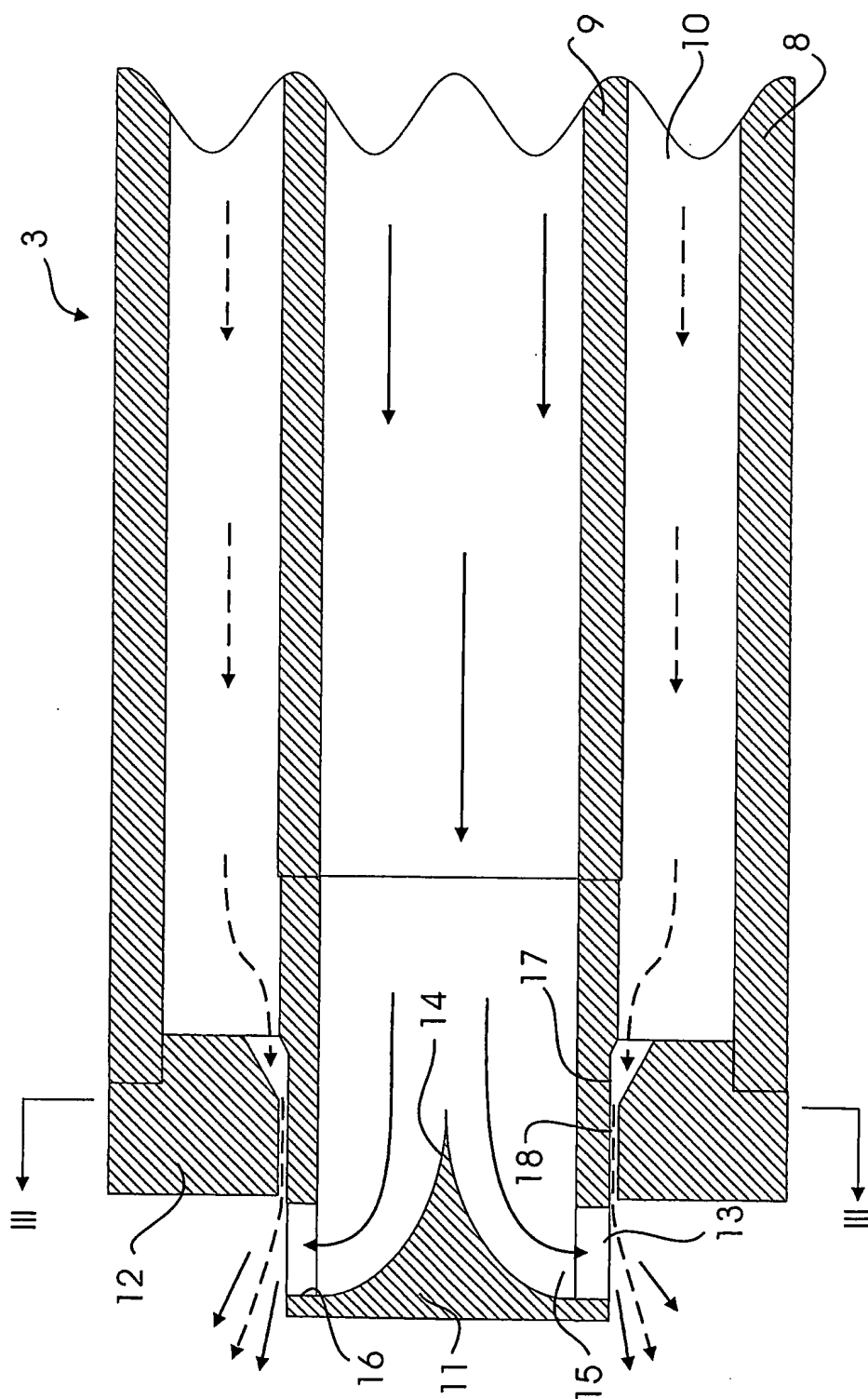


Fig. 2

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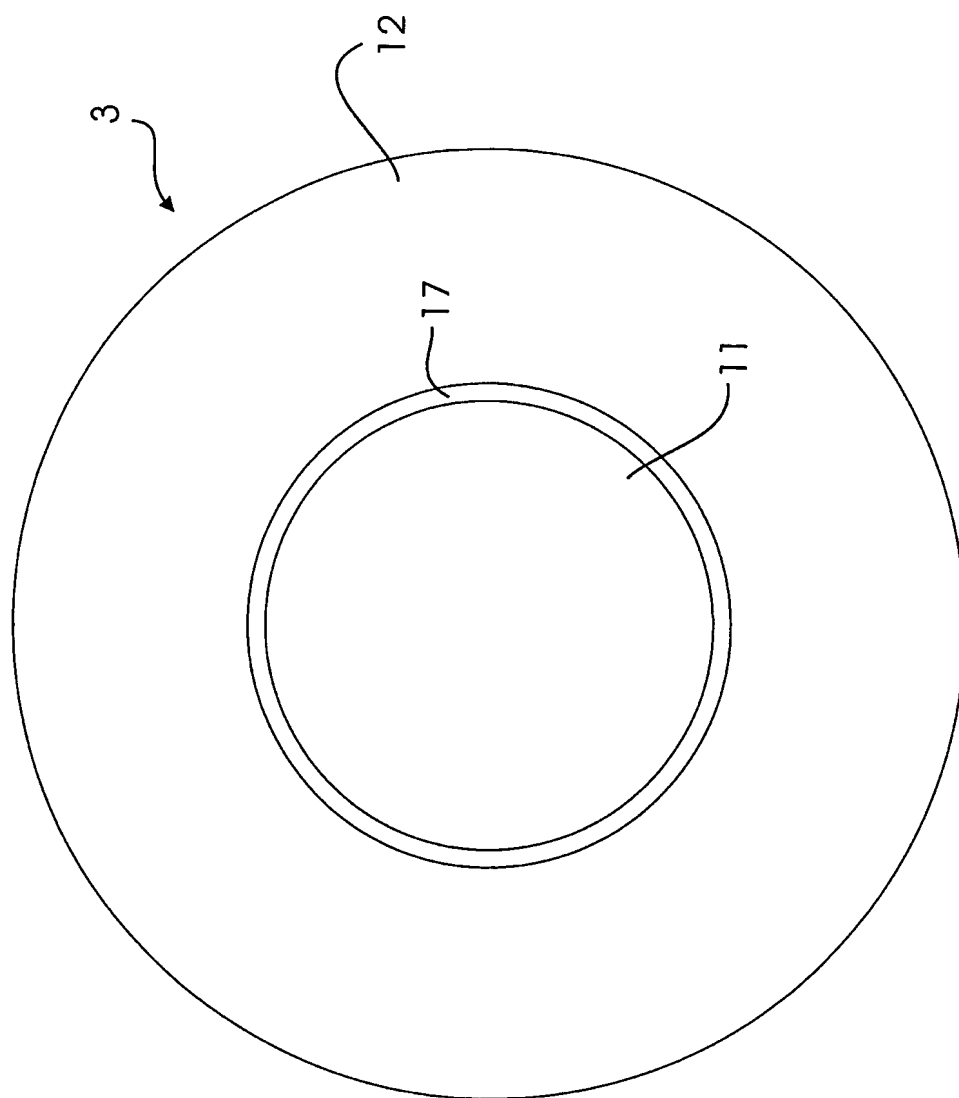


Fig.3

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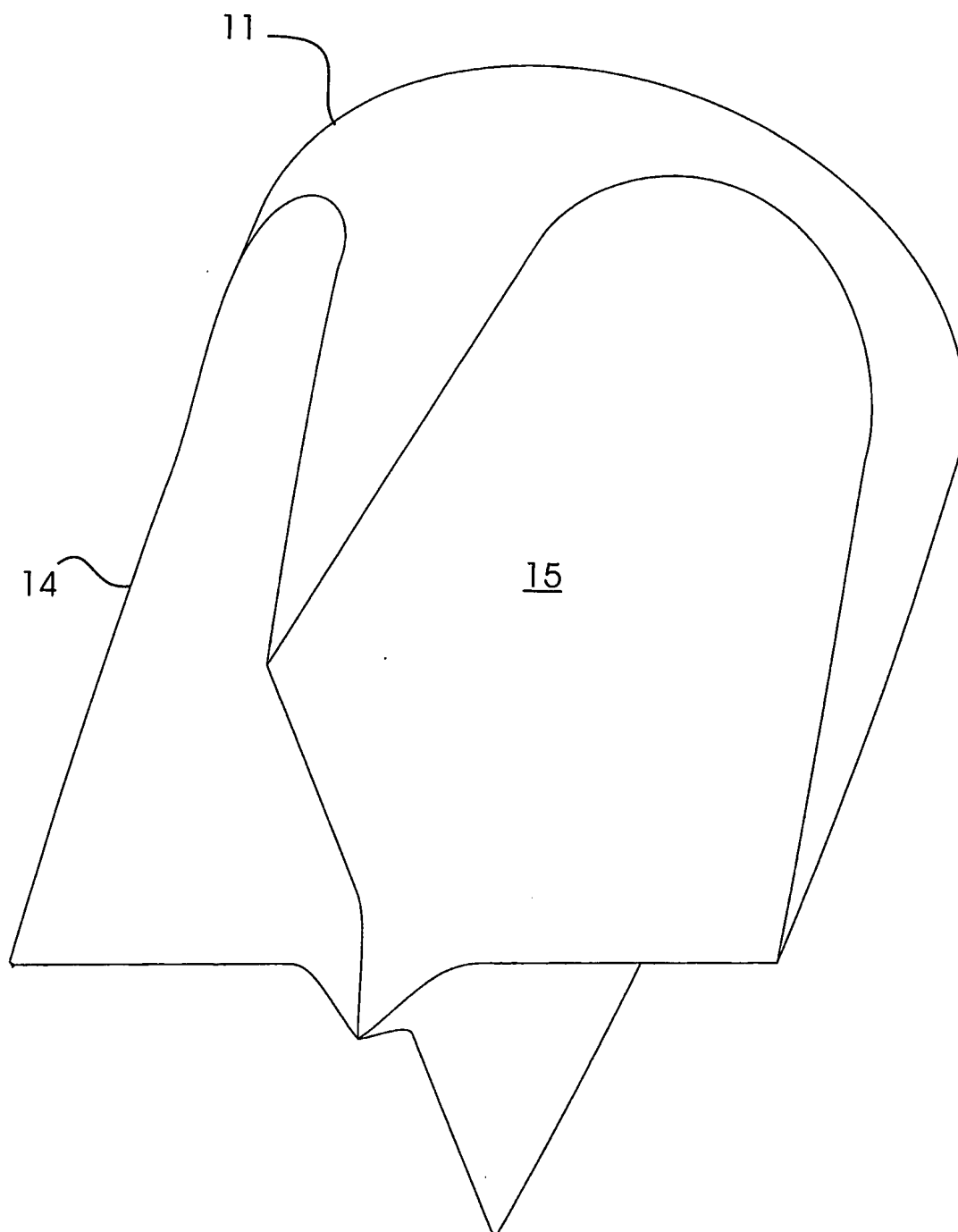


Fig.4



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 03/00598

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F23D 11/12, F23D 11/40, F23G 5/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F23D, F23G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## EPO-INTERNAL, WPI DATA

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CH 659514 A5 (BBC AKTIENGESELLSCHAFT BROWN, BOVERI & CIE), 30 January 1987 (30.01.87), page 2, column 2, line 58 - page 3, column 2, line 2, figure 1	1-3
A	--	4-10
A	US 4544095 A (KARL-AXEL LITZEN), 1 October 1985 (01.10.85)	1
A	US 4141505 A (RICHARD B. REICH), 27 February 1979 (27.02.79)	1

☒ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

- \* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search

26 November 2003

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International application No.

PCT/DK 03/00598

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

06/09/03

International application No.

PCT/DK 03/00598

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